

REMARKS/ARGUMENTS

Upon entry of this amendment, claims 1-7, 9, 11, and 14-20 will be pending in this application. Claims 1, 6, 7, and 9 are amended herein. Claims 14-20 have been added. Claim 14 is supported in the specification, for example, at page 9, lines 3-5, and by original claims 8 and 9. Support for claims 15 and 16 may be found throughout the specification, for example, at paragraph [0017]. Likewise, support for claim 17 is found throughout the specification, for example, at paragraph [0017]. Support for claims 18-20 may similarly be found throughout the specification, for example, at paragraph [0013]. Claims 8, 10, 12, and 13 have been canceled without prejudice to prosecution at a later date. No new matter has been introduced by way of this amendment.

Applicants have deleted paragraph [0009] of the specification. That paragraph describes a study which purportedly examined the effect of combining iron salt and sodium hypochlorite in a water treatment process. In accordance with the Examiner's request, Applicants have identified and obtained a copy of the document which describes this study, namely, Weber, M.D., *et al.* ("Evaluation and optimization of ferric chloride and chlorine feed rates for odor control," *WEF Specialty Conference Series Proceedings*, Odor and Volatile Organic Compound Emission Control for Municipal and Industrial Wastewater Treatment Facilities, April 24-27, 1994, 2-1 – 2-12) (hereinafter "Weber"). Upon a careful review of Weber, it has become apparent that an inadvertent error occurred in the description of the study in paragraph [0009], as Weber describes a study involving the use of a combination of an iron salt and *chlorine* on a water treatment process.

In accordance with Applicants' duty of disclosure under 37 C.F.R. § 1.56, submitted herewith is a Supplemental Information Disclosure Statement and accompanying Form PTO-1449 listing the Weber document. Applicants respectfully request that the Examiner indicate that the document cited in this Supplemental Information Disclosure Statement has been considered by initialing the PTO-1449 form at the indicated location, and that Applicants be provided with a copy of the initialed form for their records.

Applicants have discovered a novel and significant improvement for reducing hydrogen sulfide emissions from wastewater by adding an iron salt to the wastewater stream upstream of hydrogen sulfide volatilization followed by a deliberate downstream addition of an oxidant to the wastewater stream to regenerate free iron ions. Multiple benefits are derived from Applicants' invention, including extended control of hydrogen sulfide emissions and significant treatment plant benefits as a result of a reduced iron load. The invention is presented in the solicited claims.

Applicants note with appreciation the acknowledgment of the patentability of claims 2 and 11. Applicants respectfully submit that newly added claim 16 is likewise patentable.

Preliminarily, Applicants note that claims 1 and 9 have been amended to correct a typographical error in the spelling of the term "volatilization." Withdrawal of the objection to claims 1-5 and 9-13 is respectfully requested. Additionally, in response to footnote 6 of the Office action, Applicants note that they constitute the authors of the cited webpage.

I. Claims 1, 3, 4, 6, and 7 as amended herein are patentable over the Pomeroy reference.

Claims 1, 3, 4, 6, and 7 are rejected under 35 U.S.C. § 102 (b) for alleged anticipation over Pomeroy *et al.*, *Sewage Works*, July 1946, pp. 597-640 ("Pomeroy"). Applicants

traverse the rejection. Nonetheless, in an effort to advance prosecution of the application, Applicants have amended claims 1, 6, and 7 to overcome the rejection.

To anticipate a claim, a prior art reference must teach, either expressly or inherently, each and every element of the claim. *See Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631 (Fed. Cir. 1987).

It is asserted in the Office action that Pomeroy describes the addition of ferrous sulfate to a wastewater stream within a sanitary sewer, thereby allegedly generating iron (II) sulfide. It is further asserted that the process described by Pomeroy inherently adds as an oxidant oxygen found in the air to the wastewater stream, thereby regenerating free iron ions.

Applicants have amended claims 1, 6, and 7 to clarify that the addition of the oxidant to the wastewater stream is deliberate, as supported throughout the specification, for example, at page 6, paragraph [0014], by reference to the point addition of an oxidant downstream of the point of the transition metal salt addition. In contrast, Pomeroy, on page 628 of that reference, describes the natural aeration of sewage to which a ferrous salt has been added. Pomeroy nowhere describes the deliberate addition or injection of an oxidant to the sewage to be treated.

Applicants respectfully submit that the natural aeration of the sewage described by Pomeroy is insufficient to regenerate iron ions in an amount sufficient to demonstrate a significant beneficial effect downstream of the point of oxidant addition in a wastewater treatment system as presently claimed. In support of this assertion, Applicants submit herewith a Declaration of John R. Walton Pursuant to 37 C.F.R. § 1.132. Mr. Walton has more than 20 years experience in the use of chemical oxidation technologies for environmental processes, including ten years as the chief technologist for the leading multi-

product chemical service firms that specialize in the field. Through this period, he has managed or overseen more than 75 projects related to the design and operation of odor (sulfide) control processes for both municipalities (collection and treatment of water and wastewater) and industry (sour waters/sludges from petroleum operations, steel production, paper processing, food processing, geothermal operations, and chemical manufacture).¹ This technical background, combined with practical business experience, establishes his expertise in the technical field of wastewater treatment.

According to Declarant Walton, Applicants have successfully demonstrated that application of the present invention as defined by claim 1 to a large sewage system achieves an effective ratio of about 0.90 lb of ferrous ion per pound of sulfide—*i.e.*, a result 45% less than the ratio taught in the prior art. Declarant Walton describes a recent field test of the present invention in a large municipal sewage interceptor. The initial sulfide mass loading at the terminus of the interceptor was approximately 2000 pounds per day sulfide. Addition of ferrous ion to the wastewater stream 23 miles (13 hours hydraulic retention time) upstream at a rate of 1786 pounds per day, which is equivalent to a dose ratio of 0.90 pounds ferrous ion per pound sulfide, reduced sulfide mass loading at the interceptor terminus to approximately 940 pounds per day, which correlates to an effective removal ratio of 1.54 pounds ferrous ion per pound sulfide. This is 6% above theory (1.64 pounds ferrous ion per pound sulfide), indicating only marginal benefit afforded by natural aeration of the sewage.

In contrast, the addition of approximately 1625 pounds hydrogen peroxide at the interceptor midpoint in conjunction with the ferrous ion addition reduced the sulfide mass

¹ Projects described in Declarant Walton's curriculum vitae which identify iron or a salt thereof and peroxide involved either the use of catalytic iron or the use of peroxide separately from the use of iron or iron salt.

loading at the interceptor terminus to approximately 100 pounds per day, equating to a 95% reduction. This represents an effective removal ratio of 1.06 pounds sulfide per pound Fe, or inversely, an iron utilization efficiency of 0.94 pounds Fe per pounds sulfide removed. This utilization efficiency is 74% above that predicted by theory. In short, Applicants' invention provided an effective control ratio of ferrous ion to sulfide 45% less than that predicted by theory. Accordingly, the practical benefits of the present invention include a substantial reduction in the detrimental effects resulting from the addition of ferrous ion, a 45% reduction in solids production at the treatment plant, 45% less salinity, and 45% less alkalinity.

Additionally, Applicants respectfully submit that the conversion of ferrous iron to ferric iron by the deliberate addition of H_2O_2 is rapid, occurring within minutes, as opposed to allowing for natural aeration only. As demonstrated by the experimental results submitted by way of the attached Declaration of John R. Walton Pursuant to 37 C.F.R. § 1.132, without the addition of H_2O_2 , the ratio of ferrous to ferric iron is about 80:20, indicating only marginal conversion provided by natural aeration within the interceptor and treatment plant headworks. In contrast, addition of H_2O_2 shifts the ratio of ferrous to ferric ion to about 20:80 within a reaction time of about 5 minutes from the point of H_2O_2 addition.

One of skill in the art could not have predicted such superior results as those achieved by the present invention based on the teachings of the prior art. Accordingly, Applicants respectfully submit that the amendments to claims 1, 3, 4, 6, and 7 made herein overcome the rejection over Pomeroy. Withdrawal of the rejection is respectfully requested.

II. Claims 8, 10, 12, and 13 are rejected over the Pomeroy and WEF references.

Claims 8, 10, 12, and 13 are rejected under 35 U.S.C. § 103 for alleged obviousness over the Pomeroy and WEF references. Applicants disagree with the rejection. In particular, Applicants disagree with the rejection of claims 10 and 12 for the reasons asserted in Part I, *supra*. Nonetheless, in an effort to advance prosecution of the application, Applicants have canceled claims 8, 10, 12, and 13 without prejudice. Applicants respectfully request withdrawal of the rejection.

III. Claim 5 is patentable over Pomeroy in view of U.S. Patent 5,906,750 to Haase.

Claim 5 is rejected for alleged obviousness under 35 U.S.C. § 103 over Pomeroy and U.S. Patent 5,906,750 to Haase. Applicants traverse the rejection for the reasons already of record.

To establish a *prima facie* case of obviousness, three requirements must be satisfied: first, there must be some suggestion or motivation to modify the reference or to combine the reference teachings; second, there must be a reasonable expectation of success for achieving the claimed invention and its particular results; and, third, the prior art references must teach or suggest all the claim limitations. *See In re Vaeck*, 20 U.S.P.Q. 2d 1438 (Fed. Cir. 1991). Evidence of unobvious or unexpected advantageous properties, such as superiority in a property the claimed compound shares with the prior art, rebuts *prima facie* obviousness. *In re Chupp*, 816 F.2d 643, 646, 2 U.S.P.Q.2d 1437, 1439 (Fed. Cir. 1987).

Applicants respectfully submit that neither the Pomeroy reference nor the Haase patent teaches or suggests the unexpected results achieved through the deliberate addition of an oxidant to a wastewater stream downstream of the deliberate addition of an iron salt as demonstrated by Applicants (*See* Declaration of John R. Walton Pursuant to 37 C.F.R. § 1.132, submitted herewith, and Part I, *supra*). Accordingly, Applicants respectfully request withdrawal of the rejection.

IV. Amended claim 9 satisfies the definiteness requirements of the second paragraph of 35 U.S.C. § 112.

Claim 9 is rejected under the second paragraph of 35 U.S.C. § 112 for alleged indefiniteness. Applicants traverse the rejection. Nonetheless, in an effort to advance prosecution of the application, Applicants have amended claim 9 to clarify that the oxidant added to the wastewater in step (b) may be the same or different than the oxidant added downstream in step (c). Applicants respectfully request withdrawal of the rejection.

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this application are in condition for allowance. The issuance of a Notice of Allowance at an early date is respectfully requested.

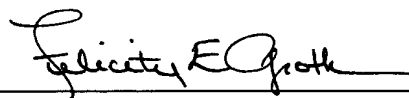
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PATENT

If the Examiner believes a telephone conference would expedite prosecution of this application, he is invited to contact the undersigned at 215-557-5908.

Respectfully submitted,

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Attachments

Supplemental Information Disclosure Statement and PTO-1449
Declaration of John R. Walton Pursuant to 37 C.F.R. § 1.132, Exhibits A and B